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WILLIAM HEDLEY,

THE INVENTOR

OF

RAILWAY LOCOMOTION

ON THE

PRESENT PRINCIPLE

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BEFORE THE INTRODUCTION OF THE LOCOMOTIVE.

WILLIAM HEDLEY,

THE INVENTOR OF

RAILWAY LOCOMOTION

ON THE PRESENT PRINCIPLE.

Archer, Mark

"Our own Engineer, HEDLEY, whose services and whose discoveries, he had often thought, had received very insufficient recognition."
—*Vide* JOSEPH COWEN, Esq., M.P., Speech on Town Moor, Newcastle, June 9th, 1881.

NEWCASTLE-UPON-TYNE:
PRINTED BY J. M. CARR, STEAM PRINTING WORKS, 21, LOW FRIAR STREET.
1882.

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DATES IN EARLY RAILWAY HISTORY.

1804		TREVITHICK'S experiments.
1811		BLENKINSOP'S cog-wheel and rack-rail arrangement.
1812		CHAPMAN'S central-chain arrangement.
„	Oct.	HEDLEY discovered and demonstrated the efficiency for traction of smooth wheels on smooth rails.
1813	Feb.	HEDLEY tried his first locomotive, which he placed on the frame he had previously used for proving the efficiency of smooth wheels. The engine short of steam power.
„	May.	BRUNTON'S Mechanical Traveller tried.
„	„	HEDLEY'S second and successful locomotive commenced work. This engine was provided with a return-tube boiler, and had the exhaust pipe carried into the chimney and upturned therein. See pages 22, 23, 26, 27.
1814	July.	STEPHENSON tried his first engine at Killingworth. Not satisfactory.
1815		STEPHENSON is said to have carried the exhaust into his locomotive chimney.
1822		STEPHENSON made five locomotives for Hetton Colliery railway.
1823		Power obtained to use locomotives on the Stockton and Darlington railway for Goods traffic.

1824 STEPHENSON and PEASE opened their factory at Newcastle-upon-Tyne, and supplied locomotives to the Stockton and Darlington Railway Co.

1827 Three of STEPHENSON'S locomotives abandoned at Hetton Colliery, and so unsatisfactory were those on the Stockton and Darlington railway, that they were likely to be disused, when

" Oct. HACKWORTH constructed the 'Royal George' with HEDLEY'S return-tube boiler.

1828 STEPHENSON adopted HEDLEY'S return-tube boiler.

" The multitubular boiler, patented in France, by M. SEQUIN.

1829 Mr. HENRY BOOTH suggested to STEPHENSON the use of small tubes to increase boiler heating surface.

" The Rainhill contest and commencement of STEPHENSON'S success.

HEDLEY'S engines on the Wylam railway, fitted in 1813 with the return-tube boiler and steam blast, were all this time working economically and well, having the great essential so long neglected or vainly sought for by STEPHENSON—sufficient steam power. See remarks pages 21, 22, 23, 24, 25.

"As far as I can gather, the report gives credit to GEORGE STEPHENSON as being the inventor of the Locomotive. Now, it has been proved that it was originated by the late WILLIAM HEDLEY, and that he had the honour of perfecting the Locomotive for practical use. We should give honour to whom honour is due."—*Vide* C. H. YOUNG, Esq; Speech at the Annual Meeting in connection with the University of Durham College of Physical Science, held at Newcastle-upon-Tyne, June 17th, 1881.

"HEDLEY—a name which would be associated in their minds, not only with a benefaction of this kind, but likewise with other achievements in other spheres to which they in that town and neighbourhood were greatly indebted—he meant the initiation of the locomotive."—*Vide* BISHOP OF DURHAM, Speech in Guildhall, Newcastle-upon-Tyne, June 2nd, 1881.

"In our admiration of the work of STEPHENSON, we must never forget WILLIAM HEDLEY, who first discovered the grand fact that the wheel of the engine upon the smooth line was sufficient to give that amount of propulsion to enable it to move and carry weight. That grand idea, the basis and bottom of all, sprang from the brain of WILLIAM HEDLEY."—*Vide* O. H. DUFFELL, Esq., Mayor of Jarrow, Speech on Town Moor, Newcastle-upon-Tyne, June 9th, 1881.

"WILLIAM HEDLEY, the inventor of the engine which was long known as 'Puffing Billy.' It was an engine, he dared say, that some of those present might have seen on the waggonway, for it was such an admirable piece of work that, although constructed by HEDLEY in the year 1812 or 1813, it was in actual work at Wylam Colliery, in 1862, in which year it was removed to Kensington Museum. That, he thought, was a great tribute to his capabilities as an Engineer."—*Vide* Mr. JOHN BURNETT, Secretary of the Amalgamated Society of Engineers; Speech on Town Moor, Newcastle-upon-Tyne, June 9th, 1881.

"They must all remember that there was WATT, TREVITHICK, and HEDLEY, all of whom preceded STEPHENSON. The mechanical appliances adopted by them were taken up by STEPHENSON, and utilised to such an extent that he developed locomotion to a great height."—*Vide* T. P. BARKAS, Esq., Speech on Town Moor, Newcastle-upon-Tyne, June 9th, 1881.

PLATE I.

FIG. 4.

This Engine was at first (1813) put upon fou
the weakness of the Wylam Railway, it was a
eight wheels, to be again restored to four wh
Wylam line was laid with edge rails. The
abandoned with the eight wheels.

It was projected, in 1820, to lay the line w
edge rail, and to have the carriage wheels red
four, connected by three teeth-wheels, as shown
B, C, but it was not done. When the alterati
carried out, five teeth-wheels were used, in o
enable the engine to go round the curves.

It had been determined not to alter the eng
long as the railway required them to be placed

K

frames, H H, I I, each frame being supported by four wheels.

S Chamber, through which the steam passed before entering the Chimney by pipe R.

× × Represents the transverse Diameter of the Fire Tube, which entered boiler at end *a* (where the fireman stood) made a circuit round interior, and returned to end *a*.

The engineman stood at *b* end.

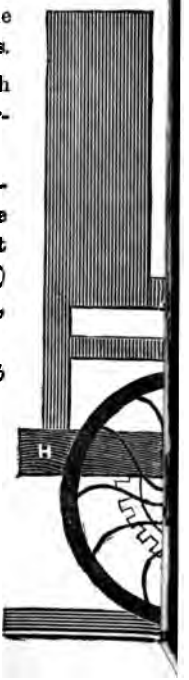


FIG. 4.

PREFACE.

THE present century will be memorable in the world's history for great engineering and scientific achievements—achievements that have already effected mighty changes in the world, and that are probably destined to effect still greater things in the future. Pre-eminent among the great productions of the century stands the Locomotive. No other product of the genius and perseverance of man can compare with the Locomotive for greatness of results; its power is ever increasing, and, in every direction, we have evidence of its services. The men to whom we owe this mighty agent have passed from among us, but their names will live in history; and the writer of this memoir is confident he needs no apology for endeavouring to do justice to one whose title to stand at the head of the list he believes to be clear and convincing, namely—WILLIAM HEDLEY.

Dr. SMILES, in his preface to the centenary edition of his Life of GEORGE STEPHENSON, refers to the labours of STEPHENSON, and details some of the advantages which society has derived from the Locomotive and the iron rail, and he remarks as follows:—"Without GEORGE STEPHENSON, Sir ROWLAND HILL might have lived in vain. It was the Locomotive that made cheap postage possible." Readers of the following pages may be inclined to go further than Dr. SMILES, and, guided by the logic of unchallenged facts, they may agree with the writer in saying:—Without WILLIAM HEDLEY, GEORGE STEPHENSON might have lived in vain. It was WILLIAM HEDLEY who gave the Locomotive its life and power, and made the work of other men possible.

NEWCASTLE-UPON-TYNE,
January, 1882.

M. Ticket

A PORTION OF AN ARTICLE WHICH APPEARED IN THE COLUMNS OF THE NORTHERN DAILY EXPRESS NEWSPAPER, JUNE 1ST 1931, HAS BEEN, BY PERMISSION, INCORPORATED HEREWITH.

WILLIAM HEDLEY.

Mr. WILLIAM HEDLEY, "the inventor of the locomotive on its present principle," was born on the 13th of July, 1779, at Newburn, near Newcastle-upon-Tyne. He was educated at Wylam, at a school kept by a noted teacher of the name of WATKINS, at whose school the late Mr. HUGH TAYLOR, as well as Mr. HEDLEY, received the rudiments of his education. Mr. HEDLEY was a good mathematician, and, before he was 22 years of age, he was appointed viewer at Walbottle Colliery, and shortly afterwards viewer at Wylam Colliery—a tribute to his undoubted ability and the early display of more than usual ingenuity. The Continental wars having increased the cost of horses and their food, Mr. HEDLEY'S attention was directed to the necessity of obtaining some cheaper mode of carrying coals from the pit's mouth to the river Tyne, where the coals were transferred to keels at Lemington, and so conveyed to the ships. The railway, from Wylam Colliery to Lemington,* was about five miles in length, and, at the time Mr. HEDLEY took the management, the way was of wood, and was worked by the old method, one horse drawing one waggon. About the year 1808, the wooden rails were taken up, and cast-iron plate-rails substituted.† These were adopted on the recommendation of Mr. THOMAS, of Newcastle-upon-Tyne, subject to a slight modification in the line of traction, which presented great undulations, and,

*A railway immortalised by accident, where the locomotive was to be baptised. The 'Model Locomotive Engineer,' by MICHAEL REYNOLDS, 1879, page 56.

† The gauge of the line was 5 feet, the same breadth as the ancient wooden-way.

consequently, was difficult to work. After this alteration, the horses took two waggons each; but the daily exertion caused by this increased drag, being too great, it was found necessary to keep spare horses. Such was the condition, we are told by Mr. OSWALD DODD HEDLEY, of this ancient line of railway, when his father's attention became fixed on the question: how can I reduce the cost of conveying the coals to Lemington? In 1811, two oxen were tried on the railway and worked for several weeks, being shod or tipped with iron; but the result was not satisfactory, as the animals were slower than horses.

The year 1812 came! Mining labour was high, and colliery materials excessively dear. HEDLEY saw that something must be done to lessen the expenses against the colliery, and, as the conveyance of the coals to the river was a large part of the expense, his attention was naturally directed to economy in that direction. To a man of his energy and ability, the idea of the colliery having to be closed was painful to contemplate; consequently, the construction of an efficient engine to convey the waggons, in place of horses, was the subject of his constant thoughts. The owner of the colliery, Mr. BLACKETT, had already caused a locomotive to be made on TREVITHICK'S plans, which never reached Wylam, it being quite useless; and had applied to TREVITHICK to make another, when the Wylam Viewer took the matter into his own hands.* The circumstances were sufficient to have deterred him. TREVITHICK, BLENKINSOP, and the CHAPMAN'S, had all tried their utmost to make

*TREVITHICK replied, saying he had declined the business, and could not render any assistance. His letter is in the possession of one of Mr. HEDLEY'S sons.

a workable locomotive, such as would supersede horses on colliery waggon-ways. They had all exercised great ingenuity, and much money had been spent, but success seemed to be as far off as ever it was.* There were many difficulties in the way, and the greatest of all was the general idea prevailing that effectual locomotion must be obtained by having some fulcrum upon which to operate with steam, or to propel by rack-work, pulling, or thrusting. As a writer in the *Newcastle Chronicle* says: Like that of many other inventions, the progress of the locomotive was arrested by an untenable assumption. To WILLIAM HEDLEY, of Wylam, belongs the merit of exploding this assumption, and getting quit of the rack rails and toothed wheels previously deemed necessary for the efficient traction of loaded waggons. Mr. HEDLEY, instead of resting satisfied with a crude preconception, interrogated nature, and in due course demonstrated that the weight of the engine produced sufficient adhesion to render all these elaborate appliances superfluous."

The importance of this apparently simple but really great discovery cannot be over-estimated. It is the basis and ground-work of locomotion, and it is almost inconceivable that the discoverer was denied credit when living, and that his memory is only now beginning to receive justice. How he made the discovery, and demonstrated the truth of his idea, will be best told in his own words.

* The system of the rack was excessively costly to lay down, and expensive to keep up. CHAPMAN'S engine worked with a chain, which frequently broke, and, although the engine had been working but for a short time, it had sunk nearly £3,000 as effectually as though the money had been thrown into a well.—The 'Model Locomotive Engineer,' by MICHAEL REYNOLDS, page 58.

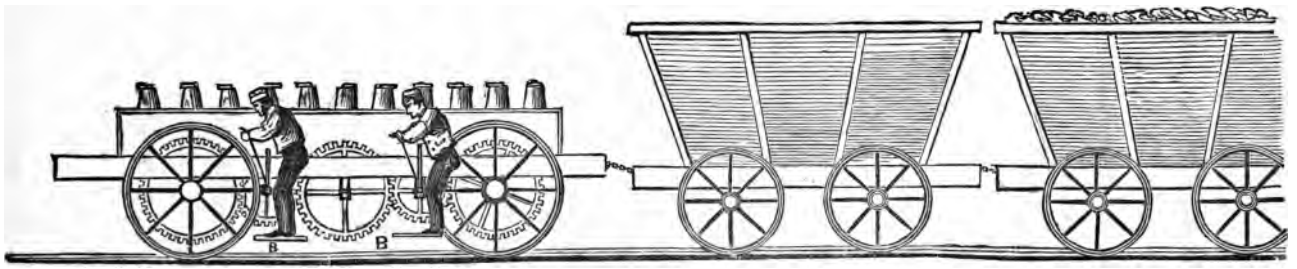
Dr. LARDNER, the great writer on scientific subjects, lecturing in Newcastle to the Literary and Philosophical Society, in December, 1836, gave GEORGE STEPHENSON the credit of being the father of the locomotive—a mistake which has been made by many less likely to know than the learned doctor. The statement was challenged by Mr. HEDLEY, in the following letter,* which was inserted for three weeks running in all the Newcastle papers of the time :—

"Shield Row, December 10, 1836.

"SIR,—I respectfully beg to call your attention to the following circumstances connected with the establishment of the locomotive engine in this district. In October, 1812, I had the direction of Wylam Colliery; at that period, I was requested by the proprietor (the late Mr. BLACKETT) to undertake the construction of a locomotive engine. The celebrated TREVITHICK had previously been applied to for one; in reply, he stated that he had declined the business. Amongst the many obstacles to locomotion at that period, was the idea entertained by practical men, and which was acted upon, viz., that an engine would only draw after it, on a level road, a weight equal to its own. To obviate this, TREVITHICK and VIVIAN proposed to make the wheels rough and uneven, &c. Mr. BLENKINSOP, in 1811, effected the locomotion by a toothed or rack rail. In December, 1812, W. and E. CHAPMAN, by means of a chain; and in May, 1813, Mr. BRUNTON, of Butterley, by movable legs. I was, however, forcibly impressed

* This letter was written hurriedly, and despatched with all speed to Newcastle, in order to reach the Doctor in time. Mr. HEDLEY had waited in Newcastle two days in order to see him, but was disappointed. The shortness of time available, no doubt prevented Mr. HEDLEY giving fuller particulars.

PLATE II.



HEDLEY'S TEST CARRIAGE.

B, B, Stages for the men to stand upon, to prevent them touching the ground. There were other two on the opposite side.

with the idea, and which was strengthened by some small preliminary experiments,* that the weight of an engine was sufficient for the purpose of enabling it to draw a train of loaded waggons. To determine this important point, I had a carriage constructed (the model of which the bearer will deliver to you); this carriage was placed upon the railroad, and loaded with different parcels of iron, the weight of which had previously been ascertained; two, four, six, &c., loaded coal waggons were attached to it, the carriage itself was moved by the application of men at the four handles; and, in order that the men might not touch the ground, a stage was suspended from the carriage at each handle for them to stand upon. I ascertained the proportion between the weight of the experimental carriage and the coal waggons at that point when the wheels of the carriage would surge or turn round without advancing it. The weight of the carriage and the number of waggons also were repeatedly varied, but with the same relative result. This experiment, which was on a large scale, was decisive of the fact, that the friction of the wheels of an engine carriage upon the rails was sufficient to enable it to draw a train of loaded coal waggons. An engine was then constructed, the boiler was of cast iron, the tube containing the fire went longitudinally through the boiler into the chimney. The engine had one cylinder and a fly wheel; it went badly, the obvious defect being want of steam. Another engine was then constructed, the boiler was of malleable iron, the tube containing the fire was enlarged, and in place of passing directly through the boiler into the chimney, it was made to

* Mr. HEDLEY experimented with coal-tubs or small waggons placed on rails *brought out of the pit.* After trying them beside his own house, the experiments *were renewed within Mr.* BLACKETT'S grounds, where greater privacy was insured.

return again through the boiler into the chimney, now at the same end of the boiler as the fire-place. This was a most important improvement. The engine was placed upon four* wheels, and went well; a short time after it commenced, it regularly drew eight loaded coal waggons after it, at the rate of from four to five miles per hour, on Wylam Railroad, which was in a very bad state; in addition to this, there was a great rise in the direction of the load in some parts of it; the road itself was of that kind termed the plate rail. It is needless to pursue the subject further than to state, that, for a length of time, each new engine went better, and took more waggons, then its predecessor.

"I should not have troubled you with the preceding exposition of facts, but in your lecture you stated that STEPHENSON was the father of the locomotive engine. Now, I do not wish to detract one iota from the celebrity to which Mr. STEPHENSON is entitled—he has done much for the locomotive engine; but by referring to Mr. WOOD'S book on Railroads, and which, as respects Mr. STEPHENSON'S exertions, may be considered good authority, it appears that a locomotive engine was not constructed by Mr. S. before 25th July, 1814. Long before this period the use of horses on the Wylam Railroad was superseded by the locomotive engines, and a large annual sum in the course of being saved to the colliery from the reduced charge in conveying the coals.

* Several of the engines constructed at first were placed upon four wheels; but in consequence of the plate rails being too slight, they were afterwards placed upon eight wheels. The railroad is now laid with edge rails, and the same engines may be seen on four wheels at this day.—'Who Invented the Locomotive?'—WARD & LOCK, 1858.

My patent bears date 13th March, 1813. (See 22nd vol., Repertory of Arts).

"In conclusion, I beg to say, I am the individual who established the principle of locomotion by the friction or adhesion of the wheels upon the rails; and, further, that it was the engines on the Wylam Railroad that established the character of the locomotive engine in this district, as an efficient, and, as put in competition with horses in the conveying of coal-waggons, an economical prime mover. After this statement, and which can be verified by many professional men in the district, I trust you will see the propriety in your future lectures of not designating Mr. STEPHENSON the 'Father of the Locomotive Engine.'

"I beg to subscribe myself, Sir,

"Your obedient Servant,

"WILLIAM HEDLEY.

"TO DR. LARDNER, NEWCASTLE."

"P.S.—I trust you will notice the contents of this letter in your lecture of this evening."*

No response was made to that challenge, and yet we find the credit again given to STEPHENSON, in 1844, by the late LORD RAVENSWORTH, then the Hon. Mr. LIDDELL, M.P., at a meeting in connection with the opening of the railway from Darlington to Newcastle. He stated that Mr. STEPHENSON was the inventor of the engine travelling with smooth wheels, an assertion which drew from Mr. THOMAS HEDLEY the following letter, addressed to the Editor of the *Newcastle Journal*:—

* Ten years before this, Mr. HEDLEY appears to have given a drawing of his locomotive to PARTINGTON, who gives an illustration of it in his book on the Steam Engine, 2nd Ed., London, 1827, and describes it on page 177.

"Sir,—In your report of the Dinner, given at the opening of the Newcastle and Darlington Railway, the Hon. Mr. LIDDELL, M.P., is represented to have said, in the presence of Mr. GEORGE STEPHENSON, that he believed Mr. GEORGE STEPHENSON constructed the first locomotive engine that ever went by its own spontaneous movement along iron rails. Now, as it does not appear that anything was said by Mr. STEPHENSON to the contrary, I feel it to be a duty which I owe to my father's memory, not to allow this statement to go forth to the world uncontradicted, but to assert that my father, the late Mr. WM. HEDLEY, and not Mr. STEPHENSON, was the first person who established and successfully carried out the principle that locomotion could be effected by the adhesion of friction of the wheels of a carriage upon a railroad.

"I am, Sir,

"Your obedient Servant,

"THOMAS HEDLEY.

"Burnhopeside, 16th July, 1844."

No reply was made to this letter, but error is easily circulated, and in this way, and by Dr. SMILES's publications, the name of STEPHENSON has received undue praise, so far as the locomotive is concerned. HEDLEY was the inventor of the locomotive on its present principle; STEPHENSON the developer of railways. That is the position of the two—but the first should take precedence, in honour as in time and in work. Mr. MATTHIAS DUNN (late Government Inspector of Mines), in his work on the Northern Coal Trade, published in 1844, gives the

following succinct account of the labours of HEDLEY's predecessors :—

"The invention of the locomotive engine was the next great era; and as this department of mechanical science has led to such incalculable national results, and influenced in an especial manner the produce and consumption of coal, it certainly deserves particular notice in this little work, inasmuch as the honour of originating it has been the subject of much controversy. In 1811, Mr. BLENKINSOP, of Middleton, near Leeds, aided by the advice and suggestions of the late Mr. JOHN STRAKER, took out a patent for a locomotive engine, to be fitted up with toothed wheels, working in a corresponding rack-rail, fixed along the centre of the railway, and which was afterwards adapted to one of the main rails. The friction and additional cost of this application was so great as to preclude any great hopes of its ever being made practically useful.* In 1812, Mr. W. CHAPMAN took out a patent for an improvement, by extending a chain along the centre of the railway, adapting the engine within certain grooved wheels, around which the chain was so led as to enable the engine to be pulled along, together with its load. This application was soon after tried at Heaton Colliery, but was not looked upon with much confidence.

"Hitherto, as will be seen by the above detail, the only feasible scheme of obtaining effectual locomotion seemed to be the procuring some fulcrum, as it were,

* The expense of laying down a strong rack along the 5 miles of the Wylam railway would have then amounted to about £8,000.—COLBURN on 'Locomotive Engineering,' page 17.

upon which to operate with steam, or to propel, by rack-work, pulling, or thrusting."

He then describes HEDLEY'S experiments, which, as he says, "proved that the friction of the wheels of an engine carriage upon the rails was sufficient to enable it to draw a train of loaded waggons." Then alluding to the engine which commenced work in May, 1813, he says:—

"A second engine was constructed with two cylinders, the boiler of malleable iron; the fire tube was enlarged, with a return tube to the chimney, now situate at the same end of the boiler as the fire-place; it was placed upon four wheels. *This engine succeeded so well that it drew eight loaded waggons at the rate of four and five miles per hour, and completely superseded the use of horses, which at that time was a ruinous expense to the colliery, and notwithstanding that the railway was upon the tram-road system. In justice, therefore, to Mr. Hedley, he is entitled to the honour of being the inventor of locomotion on the present principle.*"

The first engine mentioned in Mr. HEDLEY'S letter to Dr. LARDNER, appears to have been made at Wylam, under the superintendence of Mr. THOMAS WATERS, whose services were engaged by Mr. HEDLEY for the purpose. This engine occupied three months-and-a-half over its construction, and the story of the difficulties encountered would fill many pages. All the details had to be determined, and, in the full sense of the word, this first engine of HEDLEY'S had indeed to be *made*. It was fixed on the carriage that had proved

the efficiency of the smooth wheel and rail for traction, and began work about the beginning of 1813. As mentioned, this engine was deficient in steam-power, and, in other respects, was not satisfactory, and, after months of mental labour and anxiety, HEDLEY saw before him the necessity of having to construct another locomotive. No man ever had greater difficulties to contend with than had HEDLEY at this time; and it is greatly to the honour of Mr. CHRISTOPHER BLACKETT that he supported him throughout, in spite of the expenditure incurred and the disappointments experienced. If either of these men had flinched, the locomotive would have been abandoned. Everybody about them was against it, and advised its abandonment; but Mr. BLACKETT knew the main obstacle to success was overcome by HEDLEY'S discovery that *the law of gravitation was the true basis of locomotion.* A cordial understanding existed between these two men, and it was fortunate for the world that it was so. They decided to make another locomotive! Judged by its results, we may search history in vain for a decision of more importance. It is a small matter to consider what would have been GEORGE STEPHENSON'S future had their decision been against the making of another locomotive; but we may consider what a loss it would have been to the world. We must not forget that WILLIAM HEDLEY stood alone in his idea of the true principle of locomotion being based on the engine-carriage acting by its gravity on the rails.* The general engineering talent of the country

* Mr. BLACKETT, however, had, in 1813, an engine of this kind made, and set upon his railroad, which worked by the adhesion of the wheels upon the rails. Still, the supposed want of adhesion formed the great obstacle to their introduction, and the attention of Engineers was directed to obtain a substitute for this supposed *defect.*—WOOD '*On Railways*,' ed. 1825, page 130.

sought other aids to locomotion, and, even when the smooth wheel and rail principle was in actual operation, its importance was not immediately grasped or appreciated by others than the Wylam people. If, therefore, the decision had been to abandon the locomotive, HEDLEY'S most important discovery would, probably, have been lost to the world. Well! they decided to construct a locomotive, one that should have plenty of steam, but power had to be combined with lightness, as the rails on which the engine had to travel were very weak, being only 36 lbs. to the yard. The light plate-rails, and the undulating character of the Wylam line, were great obstacles to locomotion. Mr. HEDLEY states in his letter that the boiler of this engine was furnished with a return-flue. This was only decided upon, after long consideration of the best means to get as much heating surface as possible, and was a fortunate idea. The flue, or tube, was oval-shaped; the curved part required careful workmanship (see Plate 3, fig. 1), and some difficulty was experienced in finding anybody to undertake to make the flue. Ultimately a man named PARKER, employed at the Tyne Iron Works, Lemington, undertook to make it for the sum of five pounds. In consequence of the return-flue, the chimney of this locomotive was at the same end as the furnace. This engine was placed on four wheels, but afterwards on eight wheels, on account of the weakness of the railway, which thus did not permit the locomotive to do the work it would have done on a stronger and better line. Notwithstanding these obstacles, the engine was a decided success, and made a sensation in the neigh-

bourhood. It commenced work in May, 1813, and drew, regularly, eight loaded waggons at the rate of four to five miles per hour—good work, indeed, on such a railway. This locomotive (see Plate 1, fig. 1) will ever be famous as the first practically successful locomotive engine, and the first economical substitute for animal power. The two great features that made it at once successful and economical were—the smooth wheels acting on smooth rails by the mere weight of the machine itself; and the return-flue boiler.* As a first effect, this engine probably saved the colliery; its after effects, we may see all over the world. *That five miles of rough waggon-way*, from Wylam to Lemington, bore the first of those wonderful iron-horses that now inhabit the world, the willing servants of civilisation and commerce everywhere. There are many famous dates and famous places, but, if we consider the mighty changes effected by the introduction of locomotives, all resulting from WILLIAM HEDLEY'S ingenuity, and Mr. BLACKETT'S undaunted support, we may reasonably ask what date and what place are more worthy of fame, than May, 1813, and the old waggon-way from Wylam to the Tyne? †

After this engine performed so well, others were constructed by HEDLEY which did better work, so that the engines working on Wylam Railway, in 1815, possessed all the elements required for successful work on public railways. They had power, because of the return-flue boiler and the steam-blast in the chimney; and, if speed

*The blast was added soon after the engine commenced work.

† The locomotive received a name here, and a local habitation; and it was here that it established a right to existence, and to be improved, and helped on to maturity.—The 'Model Locomotive Engineer,' by MICHAEL REYNOLDS, page 56.

had been required, all they needed was a shorter stroke and larger wheels.* HEDLEY's idea, in causing the steam to exhaust into the chimney, through an intermediate chamber S (Plate 1, fig. 1), was to deaden the noise made by the exhaust steam. It answered the purpose, and developed another effect—the draught was increased. The pipe R (Plate 1, fig. 1) was at first made of uniform size from end to end, and was upturned about six inches in the chimney. On discovering the effect of this contrivance in generating steam, HEDLEY had the orifice of that end of the pipe in the chimney contracted, and the result was that steam was easily maintained.† Dr. SMILES, in his life of GEORGE STEPHENSON, calls this a contrivance for *preventing* a blast, maintaining that, as the steam had to pass through the intermediate chamber before entering the chimney, there could not, therefore, be any increased draught produced in the chimney. Dr. SMILES overlooks two important points—first, the fact of the Wylam engine working with a pressure of 50 lbs.; and, secondly, the diameter of the chimney being only 12½ inches. Even the gradual escape of high-pressure steam, into a chimney of that diameter, was certain to increase the draught. Other writers, including MICHAEL REYNOLDS, are inclined to deny HEDLEY the credit of having discovered the full value of the steam-blast, because of the intermediate chamber; but COLBURN,‡ in his work on locomotive engineering, says:—"Any admission of high-pressure steam into a

* ZERAH COLBURN, on 'Locomotive Engineering,' 1871, page 24.

† It is recorded that, after the orifice of the pipe in the chimney had been contracted, the sparks frequently flew out with such velocity as to set hedges and grass on fire, and damage was done in this way on several occasions.

‡ ZERAH COLBURN on 'Locomotive Engineering,' 1871, page 18.

chimney, will, if directed upwards, produce a draught, and, however much the steam may be retarded in reaching the chimney, its first escapement therein generates the action attributed to the blast pipe." The fact is that, by the combination of the return-flue boiler, the narrow chimney, and the exhaust through the chamber into the chimney, HEDLEY's engine got, and maintained, all the steam required, without making such a noise in exhausting as to cause annoyance to the neighbouring way-leave proprietor. If HEDLEY's boiler had not been able to maintain sufficient steam, it is exceedingly likely he would at once, on discovering the effect of the blast in the narrow chimney of his engine, have done what STEPHENSON was afterwards compelled to do—exhaust direct into the chimney. There was no necessity for HEDLEY to do this; but he is none the less entitled to the credit of having found out the advantage of the steam-blast, notwithstanding Dr. SMILES's anxiety to give that credit to GEORGE STEPHENSON.* We shall have some further remarks to make on this subject, after considering the position of things in connection with the locomotive in 1813 and 1814. HEDLEY's engines were beginning to attract public attention, and he was called upon to answer enquiries as to the work they could perform. There was every probability that the Wylam engines would be brought into prominence, when circumstances occurred which drew attention from Wylam, thereby probably delaying the development of the railway system

* As for the claim which has been put forward for GEORGE STEPHENSON as the discoverer of the blast pipe in 1815, it may be said that he was careful to patent his inventions, and, had the blast pipe been one of these, it would, doubtless, have been included either in his patent of February 28th, 1815, or September 30th, 1816.—COLBURN, page 19.

for many years. GEORGE STEPHENSON, the engine-wright at Killingworth Colliery (which is only a few miles from Wylam), after examining both HEDLEY'S and BLENKINSOP'S engines, had been heard to say he could make a better one, to go upon legs, which shews he had heard of BRUNTON'S strange contrivance, and also shews he had not then realised the importance of traction by the mere weight of the engine. The Owners of Killingworth Colliery, and the Viewer there, Mr. DODDS, were naturally desirous to have a substitute for horses, similar to the one in operation on the Wylam Railway, and they encouraged STEPHENSON to construct a locomotive. GEORGE STEPHENSON had everything in his favour! HEDLEY'S engine was doing excellent work, close at hand. *Its success was the very reason of the Killingworth people wishing to have a similar machine.* Instead of applying to HEDLEY for information and advice, STEPHENSON was encouraged to visit the Wylam waggon-way (greatly to HEDLEY'S annoyance), for the purpose of inspecting the engine, and carrying away all the information he could gather of its details and construction. JONATHAN FOSTER, the engine-wright at Wylam Colliery, whose duty it was to construct the second and succeeding locomotives, designed by WILLIAM HEDLEY, was a good working mechanic; and, as he was an intimate friend of the Killingworth engine-wright, the latter took the opportunities, which his frequent visits to Wylam gave him, of discussing with FOSTER everything connected with the "iron horse." There can be no doubt that FOSTER gave STEPHENSON much information. Notwithstanding these advantages, and

after taking nearly ten months over its construction, STEPHENSON'S first engine, when tried, in July, 1814, completely failed.* It was no improvement on HEDLEY'S first engine, and the disappointment of the Killingworth people must have been great. STEPHENSON'S visits to Wylam had resulted in his making a locomotive, but it was a poor copy of the original, *and it failed in consequence of not being a complete copy.* The smooth wheels were there, but the boiler was on BLENKINSOP'S principle; there was no blast in the chimney, and the chimney was three times the area of that in HEDLEY'S engine. (See Plate 1.)

Notwithstanding this failure, STEPHENSON'S experiments proceeded, and may be said to have continued until 1828 before a locomotive equal to HEDLEY'S was produced. The owners of Killingworth Colliery were wealthy and influential members of the aristocracy, and it was their influence which caused general attention to be fixed on STEPHENSON'S experiments, until the PEASE'S, and other wealthy men, became interested in his work. Thus it happened that WILLIAM HEDLEY was obscured, and the Wylam engines scarcely heard of beyond the immediate neighbourhood. Here we have fourteen years spent by GEORGE STEPHENSON (from 1814 to 1828), before he arrived at the point which HEDLEY had reached in 1813. We cannot help seeing that STEPHENSON and those about him made a mistake. Had they acknowledged the prior labours and success of HEDLEY, and sought his co-operation in the work of perfecting

* It was a great failure, and STEPHENSON, as well as the 'Grand Allies,' knew it. To add to the vexation, HEDLEY'S engines were going well; they were, at all events, more powerful, and they gave no such trouble as this 'Blucher' did.—The 'Model Locomotive Engineer,' by MICHAEL REYNOLDS, 1879, page 89. See, also, COLBURN on 'Locomotive Engineering,' page 19.

the locomotive, STEPHENSON's own labours would have been lighter, and the railway system would have been much more quickly developed.

We shall endeavour to compare together, in their principal parts, the Wylam engines of 1825, and the Killingworth engines of 1825, and shall make some further remarks on the subject of the exhaust steam. We see that STEPHENSON made his engines to run with smooth wheels, which was the great feature of HEDLEY's engine, and the ground-work of successful locomotion; and, in many minor matters, he had copied the Wylam locomotives, but, in some respects, the engines were dissimilar. Of course it was a most important point to have a boiler with sufficient heating surface to maintain plenty of steam, and HEDLEY, as we have seen, effected this in his second locomotive, by having a double-flue (see annexed Plate, fig. 1); but STEPHENSON kept on making locomotives with single-flue boilers, the flue being merely a tube, 22 inches in diameter, passing longitudinally through the boiler into the chimney (see annexed Plate, fig. 2), and having nearly two-thirds of its sectional area taken up by the masonry and fuel. The flame emerged from the furnace at once into the full size of the tube, where the heat was lost in its rapid transit to the chimney, only 5¾ feet from the point of entry. The construction was altogether rude and defective, and it seems strange that STEPHENSON should have clung to such an arrangement until about 1828.*

* Of five locomotives supplied by STEPHENSON in 1822, to work on the Hetton Colliery railway, three had been laid aside in favour of fixed engines, and, in a report on the colliery made in 1827, it was recommended as "well worthy of consideration whether it would not be advisable to substitute reciprocating engines" in place of the two remaining locomotives.—The 'Steam Engine and its Inventors.' *R. L.* GALLOWAY, 1881, page 226.

PLATE III.

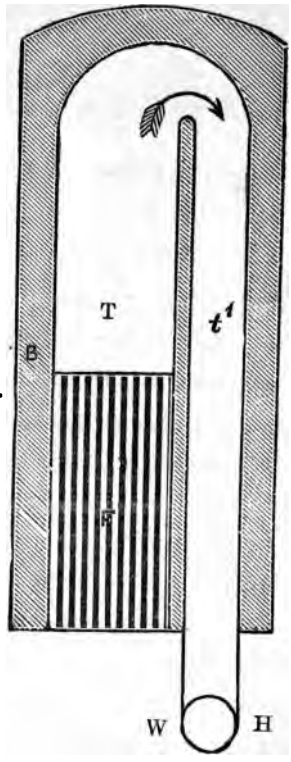


FIG. 1.

HEDLEY'S Boiler—
Horizontal Section.

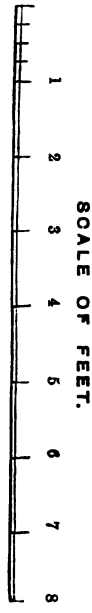
Tube or Flue T and return t^1.

F Furnace Bars.

B Boiler.

WH Chimney.

Shaded parts indicate water.



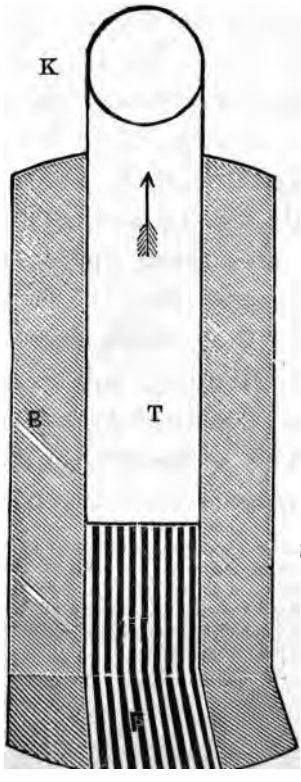


FIG. 2.

STEPHENSON'S Boiler—
Horizontal Sectio

T Tube.

F Furnace.

B Boiler.

K Chimney.

Shaded parts indicate water.

It is on record that the first locomotives supplied by STEPHENSON to the Stockton and Darlington Railway Company were all of the single-flue type, and, consequently, worked very indifferently. The Wylam engines had two 8-inch cylinders and 3 feet stroke—the Killingworth engines two 9-inch cylinders (therefore requiring more steam) and 2 feet stroke. The wheels of the Wylam engines were connected by means of teeth or spur wheels—in the Killingworth engines by an endless chain. The chimneys of the Wylam engines were 12½ inches in diameter—those of the Killingworth engines 22 inches, being merely a vertical continuation of the fire-tube through the boilers. The proper size of the chimney is an essential point in a locomotive, and GEORGE STEPHENSON seems to have had very incorrect ideas on this subject. This is, undoubtedly, the explanation of the fact that Mr. WOOD attached little value to the steam blast in the Killingworth engines. The steam ejected from the chimney made noise enough; but its effect, in increasing the power, would be almost imperceptible, owing to the immense area of the chimney, and the low-pressure steam. Mr. WOOD,* in 1825, was decidedly in favour of the same arrangement of boiler, exhaust, and chimney, as had been in operation in the Wylam locomotives since 1813, and the only inference to be drawn from that is, he knew the Wylam arrangement was satisfactory, and the Killingworth arrangement defective. Mr. WOOD, speaking of the Killingworth engines, says:—"Nothing more is wanted to destroy the noise than to cause the

* NICHOLAS WOOD, 'Practical Treatise on Railways,' ed. 1825, p. 294.

steam to expand itself into a reservoir, and then allow it to escape gradually to the atmosphere *through the chimney*. Upon the Wylam railroad the noise was made the subject of complaint by a neighbouring gentleman, and they adopted this mode, which had the desired effect." Mr. WOOD wanted the advantage of the blast, without much noise; therefore, he was in favour of HEDLEY'S arrangement, and he was quite right. If railway companies, at the present day, were compelled to abate the noise made by the exhaust steam, they would have to adopt some similar contrivance to that arranged by WILLIAM HEDLEY in 1813. STEPHENSON ultimately adopted the return-flue, and reduced the diameter of his locomotive chimneys to about the same as HEDLEY'S, which was an acknowledgment of his own error, and of HEDLEY'S sagacity. We have here shown that the Wylam engines, in 1825, were superior to the Killingworth engines in 1825; but we might almost say that HEDLEY'S second locomotive, which started in May, 1813, was better than any that STEPHENSON produced until 1828. It had the great essentials for successful locomotion—smooth wheels, connected together to secure united action; boiler of sufficient power;* steam-blast into the chimney; and a chimney of the right dimensions. It must not be forgotten that STEPHENSON had a strong railroad, with edge rails, at Killingworth, and, therefore, could have no reason for not increasing the weight of his engines. The position of affairs at Wylam was exactly the reverse of the position at Killingworth. At Wylam, the locomotive, in 1813 and 1825, was far in advance of

* ZERAH COLBURN on 'Locomotive Engineering,' 1871, page 17.—See Appendix.

the railway; at Killingworth, the railway was far in advance of the locomotive.

The claims of WILLIAM HEDLEY, to be considered the 'Father of the Locomotive,' have been put forward on various occasions; but the blaze of success surrounding GEORGE STEPHENSON has blinded peoples eyes to the justice due to others.* Dr. SMILES, and other writers, have not hesitated to give to STEPHENSON's friend, JONATHAN FOSTER, undue prominence over the construction of the Wylam locomotives. This is, no doubt, due to the source from whence they got their information—FOSTER himself—who, as a mechanic, only carried out (with the assistance of TIMOTHY HACKWORTH, then foreman of the smiths, at Wylam), Mr. HEDLEY's ideas in all the main features of the locomotives. There has also been a disposition shown to give part of the credit of HEDLEY's discoveries to Mr. BLACKETT, who would have been the first to disclaim any credit in the discoveries and labours of WILLIAM HEDLEY, other than the fact of having supported HEDLEY, if such credit had been given to him when living. The following extract from a letter received by HEDLEY† from Mr. BLACKETT, shortly after the locomotive had commenced work, will show clearly enough to whom the merit belongs. More waggons had been attached to the locomotive, and Mr. BLACKETT was informed of the work it was doing. He wrote:—

*It will, however, be seen, by a reference to the Appendix, that Mr. HEDLEY's claims have been recognised by various writers, at different times. In a very interesting pamphlet, by Sir DANIEL A. LANGE, on the 'Isthmus of Suez Canal Question, viewed in its Political Bearings,' published in 1859, he mentions Mr. WILLIAM HEDLEY as the Inventor of the Locomotive.

† The letter is still in the possession of one of Mr. HEDLEY's sons.

"DEAR HEDLEY,

"Your letter of the 6th is very gratifying, as it removes all doubt of the utility of your patent machine, which, I trust, will afford a recompense for your ingenuity. When I return home, I hope to find the 'iron horse' has taken regularly to his collar, and doing his work with becoming steadiness. * * * * * *

"When anything occurs respecting the colliery worth notice, I'll thank you for a line.

"I am,

"Very sincerely yours,

"CHR. BLACKETT.

"W. HEDLEY, ESQ."

COLBURN, in his "Locomotive Engineering," although he endeavours to make out that TREVITHICK was the author of the principal features in the locomotive, including smooth wheels, the return-tube boiler, and the narrow chimney, admits that HEDLEY was the first to bring these principles into practical operation.* He also admits that he was the first to discover and utilise the advantage of the steam-blast. After this, he proceeds to dwell on the doings of TREVITHICK, of STEPHENSON, and of HACKWORTH, placing them in the order of merit due, according to his opinion, without saying anything as to the credit and the position due to WILLIAM HEDLEY. To have been the first to bring the above-mentioned principles into practical operation, would alone entitle HEDLEY to rank first; but there cannot be a doubt that the ideas were HEDLEY'S; they were the result of intense thought

* See Appendix.

and anxiety on his part, for the reason that he knew if an efficient and economical substitute for horses could not be produced, Wylam Colliery would have to be closed.

A well-known American writer, Professor THURSTON in his "History of the Growth of the Steam Engine," page 176, writes of WILLIAM HEDLEY as being an agent of TREVITHICK in the north, and endeavours, in this way, to account for HEDLEY getting the idea of smooth wheel-traction. We have the authority of WILLIAM HEDLEY'S three surviving sons (one of whom witnessed his father's experiments at Wylam, in 1812), for saying that the statement is entirely wrong, and without foundation. THURSTON, in this statement, evidently confounds HEDLEY with WHINFIELD, who made the engine (mentioned on page 10) on TREVITHICK'S plans for Mr. BLACKETT. This engine, as already mentioned, was never sent to Wylam; it appears to have been converted by WHINFIELD into a standing engine. TREVITHICK was a man of genius; but the fact stands that he never got beyond the merely experimental and visionary stage with the locomotive; and sufficient proof of the small value set upon his experiments is afforded in BLENKINSOP'S expensive cog-wheel and rack-rail arrangement, in 1811, and the equally expensive central-chain arrangement of the CHAPMAN'S, in 1812. Several books, written in the popular style, give GEORGE STEPHENSON credit for the very first commencement of the locomotive, and hold him forth as a faultless hero, to whom the locomotive and the railway owe their birth, introduction, and present comparative perfection.

People generally—the young especially—like to read of such a man, and are reluctant to listen to the plainer, but more truthful story. Other books, again, more or less accurately describe the success of WILLIAM HEDLEY'S engine, in 1813, and, passing immediately thereafter to an account of STEPHENSON'S engine, in 1814, (so manifestly inferior to HEDLEY'S) with strange inconsistency applaud STEPHENSON, giving him honour, to which, by their own showing, he is not entitled.

REYNOLDS, in his "Model Locomotive Engineer," has done more justice to HEDLEY than many other writers, and gives him, indisputably, a foremost place on the roll of inventors. He lavishes praises on GEORGE STEPHENSON, and yet the indebtedness of STEPHENSON to HEDLEY is clearly shewn, and leads the mind of readers of the book to the same conclusion as the Editor of the *Manchester Guardian*—"It is highly probable that but for WILLIAM HEDLEY we should not have had GEORGE STEPHENSON as a railway engineer." The Editor of the *Liverpool Daily Courier*, in the course of an article on the locomotive, remarks—"It must not be forgotten that but for HEDLEY'S grand discovery, that it was possible to secure sufficient adhesion between the wheels and the rails by the mere weight of the engine, STEPHENSON'S improvements would have been of little value. Possibly, indeed, the great engineer would not have troubled himself about the locomotive, which, before Mr. HEDLEY'S discovery, had acquired a very decided reputation as a failure, being more expensive than horses and oxen." Thus, we see the truth on this subject is beginning to spread, and must,

in the end, prevail over the sentiment inspired by SMILES in favour of GEORGE STEPHENSON.

The engines built by Mr. WILLIAM HEDLEY at Wylam, in 1813, appear crude affairs as compared with the locomotives of the present day; but there was in them the germ of all that goes to make up the present locomotive. All that there is in the present locomotive for producing speed, or giving power, lies in embryo in the principal features of HEDLEY'S locomotive, of May, 1813. It is worthy of remark that Mr. HEDLEY was strongly in favour of broad gauge lines, whereas STEPHENSON'S influence and advocacy caused the general adoption, in this country, of the narrow gauge, which now threatens to cripple locomotion.*

We have given particulars of what WILLIAM HEDLEY did in regard to inventing the locomotive, and a few particulars of his other labours, and of his life's work, may be interesting to our readers. His first speculative adventure in business was in shipping, and he became a shipowner in 1808, and, afterwards, was the owner of several ships. He possessed four at the time of his death—the "Burnhopeside," "Amphitrite," "Newburn," and "Dibden."

While at Wylam, he was a volunteer in the Duke of Northumberland's Yeomanry Cavalry, which was under the command of Earl Percy, and many a long ride to drill at Alnwick Mr. HEDLEY had at that time. In the year 1822, there was a great strike of keelmen on the Tyne. At that time, the keelmen were a powerful body

* We believe the most comfortable railway travelling in this country, and where the greatest speed is attained (average of 53¼ miles per hour), is upon the Great Western (broad gauge) line, between Paddington and Swindon.

—steam has practically extinguished both them and their keels—and their work was necessary for the carrying of coal from the upper part of the river. All the coals above bridge had to be brought down in keels. It was a great strike and lasted for ten weeks. There was great disturbance at the time: sailors from Shields took the seamen out of the ships at the spouts where they were being loaded, and the Riot Act was read both at Shields and Newcastle during some of the disturbances, while a gunboat was moored opposite Newcastle Quay, and a gun fired morning and evening to let the keelmen know what was in store for them if they were refractory. This was the first time that a ship of war had been so far up the river since the rebellion in 1745, when troops were landed from a king's ship at Newcastle. HEDLEY'S locomotives had been working for about ten years, and what he then did is told by those who remember the incident:—"During the keelmen's strike, in 1822, Mr. HEDLEY caused a locomotive to be taken off its wheels, and, having had a keel brought to Newburn, he had the locomotive fixed on board, and paddles attached. The engineman of the locomotive, JOHN BELL, of Wylam (some years afterwards a driver on the Carlisle Railway), went with his engine in its new experiment, and GEORGE SOULSBY was fireman. This keel was employed towing the craft down to the ships and back again to the loading staiths, and was the means of putting an end to the strike. After the strike (of which the Wylam keelmen did not approve) was over, the keel was employed for six or eight months towing ships out to sea. River steamers were small and few in number at that time, and chiefly, per-

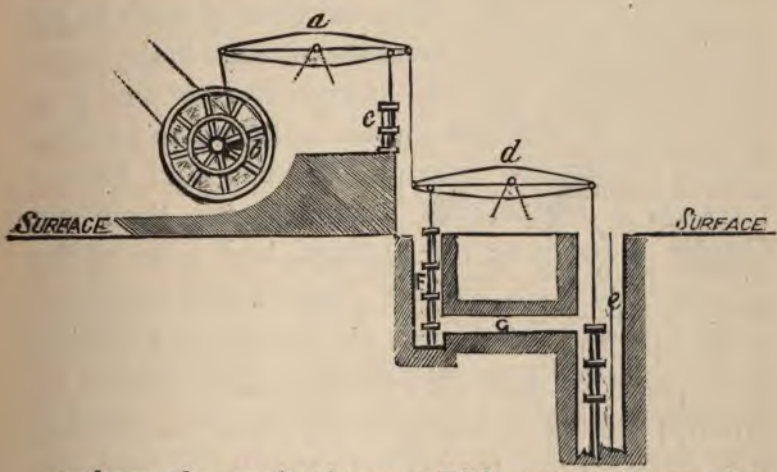
haps altogether, engaged in passenger traffic.* Ultimately the locomotive was returned to its own work on the Wylam Railway." This displays HEDLEY's character—ingenious in design, and prompt to execute. It is said the Dunston keelmen were enraged at his contrivance, and laid plans for damaging the obnoxious steam craft. The place they chose at which to intercept the craft was at the west end of the King's Meadows, an island in the centre of the river, opposite the village; but the authorities had been warned of the keelmen's intentions, and frustrated their designs. The island (caused by ages of deposit of sand and alluvial soil from the upper parts of the river) is now fast disappearing, under the influence of the powerful dredgers employed by the River Tyne Commissioners, who intend removing it entirely, and making the river available for large vessels up to Blaydon. They have accomplished the most important part of their work, by the removal of the old bridge, at Newcastle, and the substitution of it by a swing bridge, thus permitting the passage of vessels of large burthen; and one of the first to pass up the river, after the swing bridge began work, was the s.s. Carbon, belonging to the sons of Mr. HEDLEY, who, by his invention of the locomotive, gave that great impetus to trade, by which the Tyne, perhaps more than any other river, has benefitted, through the opening out of the coal-fields.

The year 1881 marks an important era in the history of the Tyne, namely, the commencement of shipbuilding on a large scale, at Scotswood, three-and-a-half miles

* This was one of the first steam-tugs on the Tyne. It is to Scotchmen we owe steam navigation. By reference to page 249 of the 'History of the Growth of the Steam Engine,' THURSTON, London, 1879, we find that, in 1814, there were five steamers in British waters, all Scotch; and, in 1820, a total of 34, one-half of which were English.

above Newcastle, and within a mile of the old coal staith at Lemington. Messrs. Campbell, Mackintosh, and Bowstead, commenced operations in the early part of the year, and, on December 3rd, the first vessel built, engined, and masted above Newcastle, passed down the river. This vessel, a fine iron screw steamer, called the "Tancarville," is estimated to carry 3,200 tons dead weight, and has been built to the order of a French firm. The immense and world-famous establishment of Sir W. G. Armstrong & Co., at Elswick, gives employment to a number of steamers bringing supplies of iron ore from Bilbao; and it is highly probable that, in the course of a few years, the Tyne above bridge will present, for two or three miles on both sides, as busy a scene as the portion between Newcastle and the sea. It would appear, from the last annual report of the chief of the United States' Statistics, the ascendancy of Great Britain in the world's international carrying trade is now more marked than at any previous period. Of the total foreign tonnage which entered American ports in the year, about 66 per cent. was British. In all other parts of the globe the ascendancy of the British merchant marine is equally marked, especially in steam vessels. This is the result of the rapid spread of the railway system, and consequent development of trade all over the world, and of the favoured position in which we are placed for building iron ships. From the day, in 1813, when Hedley's engine established the true principle of locomotion, the 'iron horse' was destined to be the great trade-producing agent of the world, which Hackworth, the Stephensons, Hawthorns, and others, made it their business to manufacture, improve, and send forth.

In the year 1824, Mr. HEDLEY took the Crow Trees Colliery, about five miles from Durham. It had been a land-sale Colliery, but he took it with a view of exporting the coal. Two years later, he took Callerton Colliery, which was near Wylam. With the latter colliery (Wylam), he shortly afterwards ceased his connection as viewer, and removed to Callerton, where he remained a short time. At this place, he put into operation an idea of his by which he caused the pumping beam of the rotating engine to do duty at both ends. Up to this time, 1828, the beam was used for pumping from one end only;* but, at Callerton, Mr. HEDLEY sunk a staple for the reception of another set of pumps, which were worked from the other end of the beam, so that the beam did double duty. The diagram shews his arrangement.



a shews the engine beam, which projected over the cylinder *c*, and gave motion to the pumping-beam

* A complicated arrangement known as the V-bob was in operation at some places for this purpose, but, when the water was to be delivered to the surface, it could not well be applied, besides being attended with other objections.

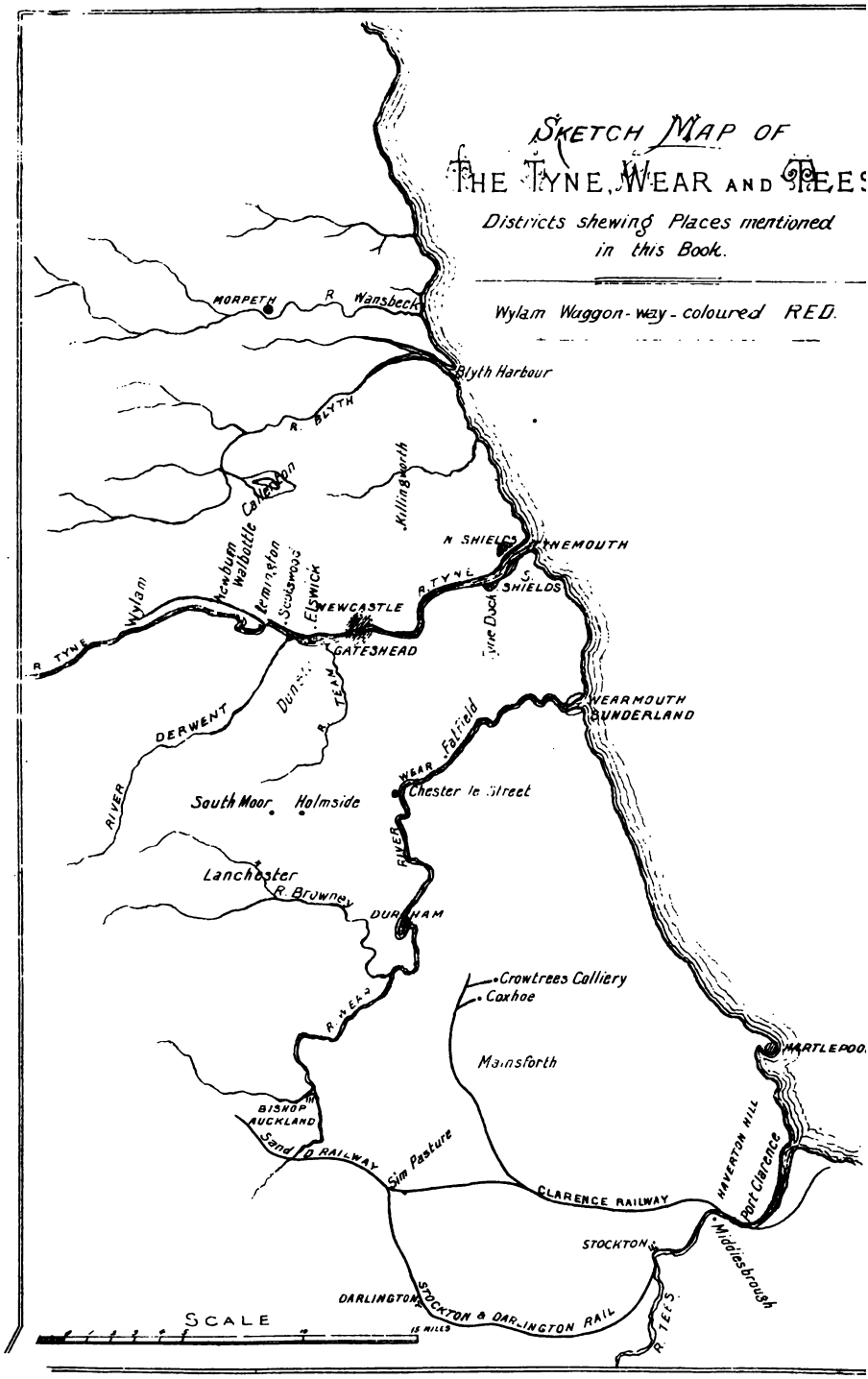
marked *d*.* The water was drawn to the drift *g*, through which it passed to the staple *f*, and that end of the beam pumped the water to surface.† *b* shews the fly-wheel and rope-roll. The arrangement was easily connected or disconnected, according as the engine was required for pumping, or for winding. Several eminent engineers watched the progress of this arrangement, and repeatedly told HEDLEY it would never answer, but its performance soon silenced criticism, and the system became general at north-country collieries.

Mr. HEDLEY afterwards took Shield Row, or South Moor Colliery, in 1828, to which place he removed, and the colliery remains in the hands of his family until the present time. Previous to this period, he was actively engaged on other matters, as will presently appear.

About the year 1824, there was an effort made to get a railway to meet the wants of the collieries in the South Durham district, and the Clarence Railway was projected; and three gentlemen were called before a Parliamentary Committee from the district,—Mr. THOMAS FENWICK, of Dipton, the Viewer for the Dean and Chapter of Durham; Mr. DAVISON, land agent of the Bishopric; and Mr. WILLIAM HEDLEY, who went down all the Collieries in the Crook district, and took samples of the coals, and prepared himself to give evidence on the subject. HEDLEY was the only engineer called to give evidence. Mr. LEATHER, of Leeds, was the Company's engineer. The bill was strongly opposed, and was not carried that year; but, the next year, the application was successful. It was intended that the Clarence Rail-

*A metal pumping beam is shown for the purpose of illustrating the principle, but the beam at Callerton was a wooden one.

† The water could be pumped to surface from both the pit shaft (marked *e*) and *the staple, if necessary.*


SKETCH MAP OF
THE TYNE, WEAR AND TEES
Districts shewing Places mentioned in this Book.
Wylam Waggon-way - coloured RED.
MORPETH
R. Wansbeck
Blyth Harbour
R. BLYTH
Killingworth
Callerton
Newburn
Walbottle
Lemington
Scotswood
ELSWICK
NEWCASTLE
GATESHEAD
Wylam
R. TYNE
N. SHIELDS
NEWMOUTH
R. TYNE
S. SHIELDS
Tyne Dock
Dunston
R. TEAM
DERWENT
RIVER
WEARMOUTH
SUNDERLAND
Fatfield
WEAR
Chester le Street
South Moor
Holmside
RIVER
Lanchester
R. Browney
DURHAM
R. WEAR
Crowtrees Colliery
Coxhoe
Mainsforth
HARTLEPOOL
BISHOP AUCKLAND
Sand
R. RAILWAY
Sim Pasture
CLARENCE RAILWAY
HAVERTON HILL
Port Clarence
Middlesbrough
STOCKTON
DARLINGTON
STOCKTON & DARLINGTON RAIL
R. TEES
SCALE
15 MILES

way should run from the Tees to the city of Durham; but it was not carried out to that extent. The opposition to the project was very great, as will be seen from the following account of the obstacles thrown in the way of the promoters, which was given in a volume issued in 1875, when the railway jubilee was held at Darlington :—

"Notwithstanding the opposition of the Stockton and Darlington Railway Company, a company was formed at Stockton, and Parliamentary sanction was obtained in May, 1828, for making this new line. The Directors included Messrs. HENRY VANSITTART, ROBERT APPLEBY, W. SKINNER, W. H. SKINNER, and HENRY BLANCHARD. The capital required was £100,000, in shares of £100 each, and the Company obtained borrowing powers to the extent of £60,000. The route of this line was as direct as it could be made between the South Durham coal-field and the banks of the Tees.* It joined the Stockton and Darlington line at Sim Pasture, not far from Shildon, and terminated below Stockton, at a place called Haverton Hill. The promoters expected that, as the distance between the South Durham coal-field and the banks of the Tees was shorter by the Clarence line than by the Stockton and Darlington, all the coals intended for export would be carried on the former route. In this expectation they were disappointed. It was necessary for the purposes of the Stockton and Darlington Railway Company that the coal-traffic should, as far as possible, be confined to their own line. Over that line they were carried before

*The line embraced both the Auckland and the Coxhoe districts. See Map.

they came upon the Clarence Railway, so that Mr. PEASE and his friends had the destiny of the undertaking pretty much at their own disposal. They, therefore, imposed a rate equivalent to 4d. per ton per mile for the whole distance between Sim Pasture and the terminus of the new railway, and made certain stipulations with regard to the use of the coal waggons which they provided, calculated to prejudice the interests of the Clarence Railway Company. The coal-traffic was not, at that time, sufficient to afford profitable employment to two rival Companies. One of them was bound to go to the wall; and the Directors of the first public railway played their cards so well, that they succeeded in practically retaining the whole of the traffic in their own hands. The Clarence Company pursued an unsuccessful career, in spite of their subsequent efforts to create a new metropolis of the iron-trade at Port Clarence or Samphire Batts, on the north bank of the Tees; and the line fell at last into the hands of the Stockton and Darlington Company, under whose management it became a not unimportant section of the route from Leeds to Ferryhill. Before finally taking leave of the Clarence Railway, we may remark, that there is now a prospect of its entering upon a sphere of greatly extended usefulness. The North Eastern Railway Company propose to construct a tunnel underneath the Tees between Port Clarence and Middlesbrough, and when this project has been accomplished, the old Clarence line will be the most direct route between the metropolis of Cleveland and the South Durham coal-field."

The Stockton and Darlington Railway, it will thus be seen, could charge a heavy rate for carrying coals over part of their line a very short distance, although the writer quoted above says that the "promoters of the Stockton and Darlington line were threatened, from the first, with the rival line to the Auckland coal-fields, but generous concessions made by Mr. PEASE quieted the Stockton recalcitrants, and indeed, caused the abandonment of the proposed competitive line," which, however, was subsequently made. But for that promise, which disarmed opposition, Mr. HEDLEY might have been connected with the first public railway in England, as he was the maker of the first working locomotive. The Clarence Railway shortened the distance between the Tees and the Crook district to the extent of seven or eight miles; and there was that in its favour. It now promises to become the direct line between Cleveland and Glasgow, if what has been hinted should be carried out—the continuing of the line to the Newcastle and Carlisle line. The Railway Company only provided the railway, and Mr. HEDLEY'S Collieries had to find the rolling stock needed, and for three years the only traffic on the line was from HEDLEY'S Collieries. The Clarence Railway had not the power, indeed, to put an engine upon the line, as that power had been opposed by Mr. SURTEES, the Historian, of Mainsforth; but at the death of that gentleman, HEDLEY got permission to put engines upon the line from Mrs. SURTEES, and he found both the engine-power and the waggons necessary for conveying the coals from Crow Trees and Coxhoe Collieries. Messrs.

HAWTHORN, of Newcastle, constructed the first engine for Mr. HEDLEY for the Clarence Railway. It was named the "Tyneside," and was the second engine that was constructed with the four fast eccentrics for the reversing motion.

Mr. HEDLEY was chiefly occupied in developing the Collieries with which he was connected, leaving others to reap the advantage of the experiments and discoveries he had made in regard to the construction of locomotives; and it may be here noted, that Mr. TIMOTHY HACKWORTH, who served under him, at Wylam, became the most formidable competitor of STEPHENSON, in the trials at Rainhill, in 1829. We believe an accident alone prevented HACKWORTH winning the contest. This able engineer carried with him from Wylam a warm feeling in favour of the locomotive; but it was when he got the appointment of resident engineer of the Stockton and Darlington Railway, in 1825, that his ability became so conspicuous. STEPHENSON'S engines, on this line, were doing so badly that, after two years' experience, the company were on the verge of abandoning steam-power in favour of horses, when HACKWORTH, at the solicitation of the shareholders, set about constructing a locomotive, the "Royal George," which commenced work in October, 1827. He adopted HEDLEY'S return-flue boiler for this locomotive,* and he discharged the steam into the chimney through a narrow orifice, which augmented the force of the blast. He also introduced important improvements of his own,

*Although it was not until 1827, or fourteen years afterwards, that STEPHENSON and HACKWORTH adopted this form of boiler, it was not greatly inferior to the *multitubular* arrangement. COLBURN on 'Locomotive Engineering,' page 17. See *Appendix.*

and he rescued the locomotive from the disrepute surrounding it, at that time, through STEPHENSON'S mistakes. HACKWORTH left the impress of his genius, in many ways, on the Stockton and Darlington Railway. He was an able man, and right worthily did he do his part, adding to his fame as an engineer, a rigid conscientiousness of conduct, deserving of the highest respect.

Mr. HEDLEY had settled the doubt by experiment and by long experience, as to whether the steam-engine could be used with profit in drawing loads on smooth lines and with smooth wheels—by mere friction, and he used that power wherever he could. South Moor, at the time Mr. HEDLEY took it, was under the "Grand Allies," and the coals were led from the colliery by horses; but HEDLEY found that LORD RAVENSWORTH set such a value upon the wayleaves, that with the drawing power that could be obtained from a horse to each waggon, it was impossible to work the colliery with profit. The waggon-way was, therefore, deviated from; a standing engine was put down to work the incline, and the coals which had been shipped at Dunston into keels, were taken to Fatfield on the Wear, which was a nearer place of shipment; but keels had there also to be used to convey the coals to the ships. An improvement in the shipment was, however, made, as the coals were put into tubs in the keels, and the tubs lifted out of the keels to the vessel, and the coals delivered without much trouble.* This method was invented by the late Mr. BELL, of Sunderland, who became one of the owners of the colliery. In 1832,

* The coals are now conveyed per the Pontop Branch of North Eastern Railway to Tyne Dock, on the Tyne, for shipment.

Mr. HEDLEY took Coxhoe Colliery, and, in 1835, the first locomotive was put upon the Clarence Railway, by him. Coxhoe Colliery was afterwards called West Hetton. Mr. HEDLEY sold it in 1837, and he sold Crow Trees, in 1838, a time when there was a great demand for collieries. He then confined his labours to the development of the Holmside, Craghead, and South Moor Collieries, which yet remain in the hands of his surviving sons, Mr. OSWALD DODD HEDLEY,* of London, Mr. WILLIAM HEDLEY, of Beechgrove, Chester-le-Street, and Mr. GEORGE HEDLEY, J.P., of Burnhopeside Hall, Lanchester. His second son, the late Mr. THOMAS HEDLEY, Barrister-at-Law, died in August, 1877, and will be remembered as having by his will left certain interests (to take effect on the death of his brother, WILLIAM HEDLEY), for the purpose of founding a Bishopric of Northumberland. We believe that, at the desire of the present Bishop of Durham, the reversionary interest of the Ecclesiastical Commissioners in this will has been purchased by Mr. WILLIAM HEDLEY, in order to help forward the formation of the new Bishopric. The sons of Mr. BELL still continue partners in the South Moor Colliery. Mr. WILLIAM HEDLEY, senior, went to reside at Burnhopeside Hall,† near Lanchester, in 1837, and he subsequently bought Newton, near Bywell-on-Tyne, the manorial rights of which were afterwards secured. Mr. HEDLEY died at Burnhopeside Hall, on January 9th, 1843, in the 63rd year of his age, and was buried at the family burial place at Newburn.

WILLIAM HEDLEY died when the railway mania was just coming to a head, and before the reaction consequent

* *This gentleman has since died.*

† *LOUGH, the Sculptor,* worked at the building of this residence, as a stone-mason.

thereon had taken place. With that, he had nothing to do. He had carried out the work that lay before him, and modestly but earnestly laboured until he had succeeded in accomplishing what he undertook. It will be seen that he was connected with improvements in connection with the transmission of coal on the Tyne, the Wear, and the Tees. On Tyneside,—and to the whole world, he introduced locomotive power; on the Wear he was connected with an improved method of delivering coals; and on the Tees he had much to do with projecting the shortest railway from the South Durham coalfield. His remains rest near where he was born, and close to the scene of his first and greatest triumph; and, for many years after his active mind had ceased its labours, the Wylam engines—the result of his genius—and the first ever made on the present principle, kept steadily doing their work on the railway that ran not far from the churchyard on the line from Wylam to the Tyne, for the engines ran on the line until the colliery was closed, in 1862.

One of the engines made by Mr. HEDLEY was purchased about that date by the Patent Office, for the South Kensington Museum, where it is exhibited as the oldest locomotive in existence, and another is in the possession of his sons, and is carefully preserved at Craghead Colliery.* The following facts are indisputable :—

"WILLIAM HEDLEY conceived the idea of locomotion with smooth wheels on smooth rails, and carried the idea into successful operation."

* Now in Edinburgh Museum of Science and Art, Nov 1882

"He constructed the first practically successful and economically working locomotive engine."

"GEORGE STEPHENSON found WILLIAM HEDLEY'S locomotive in successful operation, and copied it in most of its details, excepting the boiler and chimney. In 1828, STEPHENSON'S engines were looked on with disfavour, while HEDLEY'S engines had all along been working satisfactorily, and thus, by not adopting HEDLEY'S boiler at first, STEPHENSON actually delayed the development of the railway system, and, consequently, his own success, for many years."

"STEPHENSON ultimately adopted HEDLEY'S form of boiler,* and narrowed his locomotive chimneys, after HACKWORTH had constructed the "Royal George."

In closing this memoir, we cannot do better than commend to general attention the following extract from WILLIAM HEDLEY'S letter to Dr. LARDNER, in December, 1836:—"I am the individual who established the principle of locomotion by the friction or adhesion of the wheels upon the rails; and, further, it was the engines on the Wylam Railroad that established the character of the locomotive engine in this district, as an efficient, and, as put in competition with horses in the conveying of coal-waggons, an economical prime mover."

That emphatic declaration was published for three weeks running in all the Newcastle papers of the time—

* He also further endeavoured to meet the difficulty by doubling the flue, the last engine which he constructed for the Stockton and Darlington Railway, previous to the building of the Rocket, being constructed with a double tube, which thus presented a considerably greater surface to the fire.—SMILES' 'Life of GEORGE STEPHENSON,' page 283.

when nearly all the actors in connection with the early locomotives and railways were living—and it remained unchallenged.

We think this requires no comment; and, in reflecting upon the immense importance to which railway locomotion has attained, and the great benefits it has bestowed upon mankind, the natives of Tyneside, and all Englishmen, have reason to feel proud of the man, and proud of the district.

STATISTICS OF RAILWAYS IN THE UNITED KINGDOM, ON DECEMBER 31ST, 1880.

Miles Open.	Capital. £	Net Receipts. £	Locomotives.	Carriages, &c.	Waggons, &c.
17,933	728,316,000	31,890,000	13,384	52,530	379,930

The other States of Europe have a total railway system of about 89,000 miles, with an immense capital invested.

In the United States of America there are, at the present date (1881), nearly 100,000 miles of railway open.

In other parts of the world, especially in the British Colonies, and in India, railways are making rapid progress.

The opening of the Suez Canal has had an important influence in developing British trade and Indian resources, and, with this wonderful undertaking, the name of Sir DANIEL ADOLPHUS LANGE will be inseparably connected. We hear much of M. de LESSEPS, but, in all probability, the political, and commercial or pecuniary obstacles to the construction of the Canal, could not have been overcome, without the able and indefatigable aid of the first-named gentleman.

APPENDIX,

CONTAINING EXTRACTS FROM THE OPINIONS OF MANY WRITERS.

From HAYDN'S *Dictionary of Dates.*

"WILLIAM HEDLEY, of Wylam Colliery, made the first travelling engine (locomotive) or substitute for animal power, 1813."

From WOOD, *on Railways, 1st Edition, 1825, page 135.*

"It was, however, a question of the utmost importance to ascertain if the adhesion of the wheels of the engine upon the rails was sufficient to produce a progressive motion in the engine when loaded with a train of carriages, without the aid of any other contrivance, and it was by the introduction and continued use of them upon the Wylam railroad that the question was decided."

From the British Almanack for 1837.

"It is a singular and instructive fact, in the early history of locomotive carriages, that their projectors assumed the existence of a difficulty which is now known to be altogether imaginary; and that they set their ingenuity to work for the discovery of means for overcoming the presumed obstacle, without ever judging it necessary to ascertain, as they might have done, by very simple means, either the reality of the difficulty, or its degree, if it should be found to have existence. 'They assumed that the adhesion of the smooth wheels of the carriage, upon the equally smooth iron rails, must necessarily be so slight, that if it should be attempted to drag any considerable weight, the wheels might, indeed, be driven round, but the carriage would fail to advance, because of the continued slipping of the

wheels, or, at best, that a considerable part of the impelling power would be lost through their partial slipping. As a remedy for this supposed evil, TREVITHICK provided, for the rims or tyres of his wheels, projections similar to the heads of nails, or, otherwise, made their surfaces uneven by cutting in them transverse grooves. Following up this provision, he further proposed that, wherever, as in ascending elevations, any greater amount of the evil was to be apprehended, additional claws or nails should be projected from the rims of the wheels, in order more effectually to take hold of the road. A more elaborate invention was made the subject of a patent by Mr. BLENKINSOP, in 1811. This consisted of a rack placed on the outer side of the rail, into which a toothed wheel worked, and thus secured the progressive motion of the carriage. Another contrivance, for this purpose, was a chain placed along the road between the two rails, and passed over a wheel under the centre of the carriage, provided with upright forks to catch the links. The friction of the chain caused a great waste of power, and this contrivance was soon abandoned. The more ingenious idea of machinery, which, by its motions, should imitate the action of the hind legs of a horse, and thus secure the progress caused by the engine, was taken up by several clever men, and, for some years, was the object of their inventive powers. One gentleman, of considerable engineering talent, who had succeeded, to his own satisfaction, in providing substitutes for the hind legs of a horse, carried his idea of imitating nature so far, that he tasked himself to the production of a pair of front legs also; and he had, already, made great progress in the composition of his factitious horse, when the discovery was made that all these contrivances were needless, and that nature, in this case, required not any imitation, having herself provided, by an immutable law, that the adhesion of the wheels with the surface of the rails upon which they are moved, is amply sufficient to secure the advance not only of a heavy engine but an enormous load dragged after it.'"

From View of the Coal Trade of the North of England, by MATTHIAS DUNN, 1844.

See Pages 17 and 18 of this Memoir.

From the Archæology of the Coal Trade, by T. JOHN TAYLOR, *London, 1852.*

"A doubt on this point was esteemed the chief difficulty in the way of establishing locomotion successfully, until the question was decided by the continued use of the locomotive engine on the Wylam Coal Railway."

From a Letter signed 'Justitia' in the Mining Journal, October 6, 1860.

"In 1812, WILLIAM HEDLEY, of the Wylam Colliery, demonstrated, upon a working scale, that the mere friction of the wheels of a heavy carriage upon the smooth rails of a tramway was sufficient to enable it to draw a train of loaded waggons, and, by the early part of 1813, he had constructed a steam locomotive upon this principle, which was then and there put into working use for drawing the coals from the pit's mouth to the river.

"In 1814, GEORGE STEPHENSON, after repeatedly inspecting WILLIAM HEDLEY'S engine at Wylam, constructed an engine himself at Killingworth Colliery, for Lord RAVENSWORTH, which was employed in drawing coal waggons, as in the last named instance."

From the Illustrated London News, October 15, 1864.

"On the south side of the Museum are a couple of locomotive engines—old, very old—worn, bent, bruised, and rusty, but full of interest; for one is the oldest locomotive engine in existence, the parent of all that have since been produced, the original old 'Puffing Billy,' of the Wylam Colliery, constructed there in 1813, by WILLIAM HEDLEY, for CHRISTOPHER BLACKETT, whose name will ever be remembered as one of the earliest and

staunchest friends of the locomotive. This 'Puffing Billy was not the first engine of Mr. BLACKETT'S. He had tried TREVITHICK'S and other inventions, and had been nearly blown up several times, but at last this homely-looking, sturdy machine was perfected, and, from that date, 1813, up to a comparatively recent period, it has been dragging—very slowly, it is true—heavy loads of coals and waggons to and fro. It has a battered, and bruised, and hard-worn look, with indubitable marks of extreme old age about it, but it was a good, hard-working, willing drudge, and has well earned the quiet time it will have in future here in the Kensington Museum. Upon one side of it hangs a document, dated 1815, from which it appears some great objection had been made by local landowners to the puffing propensities of the aforesaid 'Billy,' and a case is referred for opinion to a barrister, named WILLIAMS, whose opinion is that there is no objection, arising from the lease itself, to Mr. BLACKETT conveying his coal-waggons by means of this steam engine; but he thinks that the use of such an engine may be deemed a nuisance if the smoke or noise of the engine disturbs the cattle grazing on the lands adjacent to the waggon-way. The locomotive had a narrow escape of being put down as a common nuisance. We might now as easily think of putting down earthquakes or eruptions of volcanoes as putting down the locomotive; but, in those days, it was different, and had an extinguisher been put on 'Puffing Billy' at that time, the introduction of locomotives and railways for passenger traffic might have been delayed for many years."

From the National Encyclopædia. MACKENZIE, *London*, 1864. *Article: 'Locomotive.'*

"After various inventors had long exerted their ingenuity in vain to give the locomotive a firm hold of the track, by means of roughened wheel tires, rackwork rails, and toothed driving wheels, legs and feet, and other contrivances, WILLIAM HEDLEY,

in 1813, made the important discovery that no such aids are required, the adhesion between smooth wheels and smooth rails being sufficient."

From the Times, January 21, 1865.

"In this engine, the two great features, which made the locomotive a success, were first applied—the sufficiency, for traction, of the smooth rail and wheel, and the steam blast up the chimney. The sufficiency of the smooth rail and wheel for traction, was, indeed, the great principle, the establishment of which rescued the locomotive from oblivion. The only means by which heavy loads could be drawn by locomotive power, before HEDLEY's time, was by the employment of the toothed-wheel and the racked-rail, as introduced by BLENKINSOP and TREVITHICK, but 'the pull' tore up the racked-rail, and, consequently, this system had to be abandoned for horses. * *

"There is one other feature in the old Wylam engine which is worthy of notice. The fire-tube doubles upon itself, the chimney coming out beside the furnace door. This length of heating surface gave it an immense advantage over all previous colliery-engines; indeed, neither STEPHENSON's Killingworth engines, nor those that worked the Darlington line, were so constructed, and consequently were so far deficient in powers of getting up steam. * * * * * *

"The establishment of the locomotive factory did more, perhaps, towards establishing STEPHENSON's fame than anything else."

From Locomotive Engineering, by ZERAH COLBURN, *London*, 1871.

PAGE 16.

"HEDLEY, acting for Mr. BLACKETT, was, no doubt, the first to work up the adhesion of the driving-wheels upon a commercial scale."

PAGE 17.

"Apart from the use of smooth driving-wheels, HEDLEY's engine embodied two improvements of much importance.

TREVITHICK was, perhaps, the author of both these improvements, judging from his original drawing of 1803 ; but it is not certain that HEDLEY was not the first to bring both into actual use.* The return-flue boiler not only gave additional heating surface, but the course of the flame was rendered more effective on a given area, as a square foot. Although it was not until 1827, or 14 years afterwards, that STEPHENSON† and HACKWORTH adopted this form of boiler, it was not greatly inferior to the multitubular arrangement ; and, indeed, the 'Sanspareil', with the return-tube boiler, was the most effective engine brought forward at the Liverpool and Manchester contest, and, but for an accident, in no way attributable to the principle of the engine, would, perhaps, have won the prize awarded to the 'Rocket.' HEDLEY'S other improvement was of not less consequence, and consisted in adopting a small diameter, about one foot, for the chimney.

He then proceeds to say that, although not mentioned in Mr. HEDLEY'S letter to Dr. LARDNER,‡ it is certain the steam of his locomotive was discharged through the chimney, and disposes of the objection of Dr. SMILES to give HEDLEY the credit of discovering and utilising the advantage of the steam-blast, on account of the intermediate chamber, in the words already quoted on pages 22 and 23. See also note, page 23.

PAGE 29.

"The real power of the 'Sanspareil' is to be estimated by its rate of evaporation, which was one-third greater than that of the 'Rocket,' and thus, the 'Sanspareil,' after allowing for its greater weight, was the most powerful engine brought forward at the trial.

* * * * * * * *

"It is a common, but erroneous, opinion that the adoption of locomotive power upon passenger railways, and the consequent

* Refer to pages 30 and 31.
† Should have read HACKWORTH, then STEPHENSON, &c.
‡ See note, page 12.

great results to which railways have attained, since 1829, are due to the success of the 'Rocket.' The history of the Rainhill contest does not, however, warrant this conclusion, and it is not, indeed, improbable that the progress and success of the modern railway system would have been nearly the same had the 'Rocket' never existed."

PAGE 30.

"No particulars can now be obtained as to the coal burned and water evaporated in HEDLEY'S engines; but an examination of the results attained by other engines, having boilers of like construction, justifies the presumption that the Wylam locomotives worked with greater economy of fuel than any others made prior to the 'Royal George,' in 1827."*

From Discoveries and Inventions of the 19th Century, by ROBT. ROUTLEDGE, *1877.*

"But for this discovery, the locomotive might never have emerged from the humble duty of slowly dragging coal-laden waggons along the tramways of obscure collieries."

From the Model Locomotive Engineer. By MICHAEL REYNOLDS, *London, 1879.*

PAGE 59.

"The Wylam colliery viewer turned the subject over in his mind, looking first at the rack-engine and then at the chain-engine, until it occurred to him that it might be possible to dispense with both systems. At least, he thought so, and he would try it. Try it he did, at Wylam; the date is given as October, 1812, when his experimental carriage was placed upon the railway. The object of this experiment was to prove, and, as it turned out, to settle for ever, that BLENKINSOP'S rack and CHAPMAN'S chain could be thrown aside. It was exactly the kind of test one would expect to see made at that time, nothing

* The whole of these extracts from COLBURN bear out our remarks on pages 25 and 26.

could be more in keeping with the question of the hour. HEDLEY was the man; Wylam the place; October, 1812, the time.

PAGES 61 and 62.

"Great credit is due to WM. HEDLEY for this discovery, this great discovery. He was confident that the principle was right, and he exhibited not the slightest degree of indecision, but was resolved to try again. Make another locomotive? Yes, that he would, and sure enough he did. His next engine was a success, and excited great interest throughout the mining districts. The engine is now in the South Kensington Museum. People from all parts came to see the iron and steam horses, which were called by the workmen 'dillies'."

PAGE 65.

"The second engine at Wylam, by its practical success, set aside rack-rails, chain-barrels, and moveable legs. It brought locomotive science nearer to the true principle than any engine before it had done."

PAGE 67.

"As we have faithfully traced the progress of the engine, it was not necessary, up to this point, to make mention of the name of STEPHENSON, since he had no connection with the locomotive until some time after it was put to work on the Wylam Railway under Mr. HEDLEY, who made the way for STEPHENSON, and gave him a good start at Killingworth."

PAGE 79.

"All the salient parts of the engine were carried away to Killingworth, and after mastering all the arrangements, the task of making an engine forced itself upon his* attention day and night."

PAGE 84.

"The locomotive had already been invented; six individuals had before him experimented upon it, the last of whom was

* Stephenson's.

HEDLEY, and he had made an efficient and economically-working locomotive engine."

PAGE 106.

"The locomotive, at this very period, was generally in great disrepute. In many ways it had improved, but, after all, it was a costly article. A good deal of this was caused by STEPHENSON himself not availing himself of the best boiler at first. In 1828, he employed a return-flue boiler, as HEDLEY had done in 1815.* Here we have twelve† years in which the best boiler was disregarded. The complaint was always that there was a want of steam. It was an enormous sacrifice on the part of STEPHENSON to ignore HEDLEY'S boiler for so extended a period."

From the History of the Growth of the Steam Engine, by PROFESSOR THURSTON, 1879.

Pages 182 and 183.

"This carriage was loaded with heavy masses of iron, and attached to trains of coal wagons on the railway. By repeated experiment, varying the weight of the traction carriage and the load hauled, HEDLEY ascertained the proportion of the weight required for adhesion to that of the loads drawn. It was thus conclusively proven that the weight of his proposed locomotive engine would be sufficient to give the pulling-power necessary for the propulsion of the coal-trains which it was to haul.

"When the wheels slipped, in consequence of the presence of grease, frost, or moisture on the rail, HEDLEY proposed to sprinkle ashes on the track, as sand is now distributed from the sand box of the modern engine. This was in October, 1812.

"HEDLEY now went to work building an engine with smooth wheels, and patented his design, March 13, 1813, a month after he had put his engine at work. The locomotive had a cast-iron boiler, and a single steam-cylinder, 6 inches in diameter, with a small fly-wheel. This engine had too small a boiler, and he soon after built a larger engine, with a return-flue boiler made

* 1813. † Fourteen.

of wrought-iron. This hauled 8 loaded coal wagons 5 miles an hour at first, and a little later 10, doing the work of 10 horses. The steam pressure was carried at about 50 pounds, and the exhaust, led into the chimney, where the pipe was turned upward, thus secured a blast of considerable intensity in its small chimney. HEDLEY also contracted the opening of the exhaust-pipe to intensify the blast, and was subjected to some annoyance by proprietors of lands along his railway, who were irritated by the burning of their grass and hedges, which were set on fire by the sparks thrown out of the chimney of the locomotive. The cost of HEDLEY'S experiment was defrayed by Mr. BLACKETT.

"Subsequently, HEDLEY mounted his engine on eight wheels, the four-wheeled engines having been frequently stopped by breaking the light rails then in use. HEDLEY'S engines continued in use at the Wylam collieries many years. The second engine was removed in 1862, and is now preserved at the South Kensington Museum, London.

"GEORGE STEPHENSON, to whom is generally accorded the honour of having first made the locomotive engine a success, built his first engine at Killingworth, England, in 1814."

From the Steam Engine and its Inventors. ROBERT L. GALLOWAY, 1881.

PAGES 219 AND 220.

"The many schemes which were on foot to effect locomotion by steam, caused the year 1813 to be a memorable one in the history of the locomotive engine. Three locomotives, each acting on a different principle, were set to work on three different colliery railways on the north side of the river Tyne—Messrs. CHAPMAN'S chain-engine, on Heaton Colliery railway; HEDLEY'S smooth-wheeled engine, on Wylam Colliery railway; and one of BLENKINSOP'S engines, on the Kenton and Coxlodge railway.

"Regarding Messrs. CHAPMAN'S engine, it need only be remarked that the chain was found to give rise to great friction, and the engine to be very liable to get out of order, on which account it was soon abandoned."

PAGE 221.

"It was by the introduction and continued use of smooth-wheeled engines on the Wylam railway, that the absence of the necessity for any further aid than that supplied by the adhesion of the wheels to the rails was satisfactorily demonstrated."

PAGE 222 (NOTE).

"BLENKINSOP'S locomotive appears not to have remained long in use on the Kenton and Coxlodge railway, the gradients being, probably, too heavy for it."

PAGES 224 AND 225.

"The regular working of the smooth-wheeled locomotive, on the Wylam railway, had shown that, on railways deviating but little from a dead level, the patent rack-rail, with its corresponding pinion, was not essential. STEPHENSON accordingly decided to make use of smooth wheels."

From GEORGE STEPHENSON, *the Locomotive and the Railway. By* JOHN F. LAYSON, *1881.*

"Of the various mechanical contrivances now in use, none have created a more thorough revolution in the condition and habits of civilized nations than the locomotive. The offspring of the genius of TREVITHICK, but soon abandoned by its erratic parent, the nursling was adopted by WILLIAM HEDLEY, of Wylam, who taught it to progress without extraneous help."

From the Life of GEORGE STEPHENSON. WARD, LOCK, & Co., *London, 1881.*

"Mr. HEDLEY made the important discovery, by experiment, that a smooth rail would offer sufficient friction to enable the wheels of an engine to advance upon it, if the weight of the engine was made proportionate to the load it had to drag; and

that the rack-rail and toothed-wheels were therefore unnecessary. It had been always thought that engine-wheels on a smooth surface would 'surge' or slip round without advancing. Mr. HEDLEY was soon able to report so favourably to Mr. BLACKETT, in London, concerning the working of the engine, that the latter wrote a congratulatory letter, expressing his satisfaction that 'the iron horse had taken to the collar so kindly.' 'Puffing Billy,' as the first Wylam engine was called, soon became one of the lions of the district. Of course it met with a certain amount of opposition, part of which proceeded from the workmen themselves, ever jealous of the introduction of machinery; and Mr. BLACKETT was obliged to compromise with a determined opposition, by undertaking to stop the engine when any horses came in sight on the Wylam road. Many, also, were inclined to sneer at the experiments, and had much to say on the absurdity of taking up with 'new fangled notions,' and the loss of time, temper, and money usually consequent on such a course. But 'Puffing Billy' snorted gaily along the Wylam tramroad, impervious to hostile criticism, and deserves, with his constructor, honourable mention in the history of the invention of the locomotive engine."

From the North of England Advertiser, May 21, 1881.

"Mr. HEDLEY doubted the necessity for such an arrangement, and he had a carriage made expressly to test the truth of his suspicion. It was made to run on four wheels, which were actuated by cog-wheels, worked by four men, two on each side, and it was loaded to represent the weight of an ordinary locomotive. The result was to establish, beyond question, the fact that the friction of the wheels on the rails was alone sufficient to enable an ordinary engine to drag behind it a train of carriages. This was a most important advance in the history of the locomotive. Mr. BLACKETT was now satisfied that no insurmountable difficulty stood in the way of successfully placing the steam-engine upon wheels, and using it for purposes of locomotion,

and he no longer hesitated to incur the expense of a trial. The first attempt was, however, a failure. The boiler was of cast-iron, with a horizontal tube (or flue) through the centre to assist in the raising of steam, the supply of which was, nevertheless, still defective. Mr. HEDLEY had, however, gained experience, and he commenced to build what may be described as the first successful locomotive, now in Kensington Museum."

From the Manchester Guardian, June 3, 1881.

"It was these experiments at Wylam that demonstrated the needlessness of rack-rails, endless chains, and other similar contrivances, for they showed clearly that the weight of the engine would produce sufficient adhesion to enable it to haul after it the required number of waggons on the smooth tramroad in any sort of weather. This was a great step forward, and, for the first time, a cheap and efficient railway locomotive was actually at work. It is a matter of history that HEDLEY'S engine was seen and studied by STEPHENSON before he began to construct the 'Blucher,' of Killingworth; and, it is equally notorious, that his first engine was decidedly inferior to that of HEDLEY. How he persevered and went forward from comparative failure to fabulous success has been told too often to need repeating here. It is highly probable that, but for WILLIAM HEDLEY, we should not have had GEORGE STEPHENSON as a railway engineer."

From the Liverpool Daily Courier, June 7, 1881.

"It must not be forgotten that, but for HEDLEY'S grand discovery that it was possible to secure sufficient adhesion between the wheels and the rails by the mere weight of the engine, STEPHENSON'S improvements would have been of little value. Possibly, indeed, the great engineer would not have troubled himself about the locomotive, which, before Mr. HEDLEY'S discovery, had acquired a very decided reputation as a failure, being more expensive than horses and oxen."

From the Mining Journal, June, 1881.

"Although no one would desire for one moment to ignore the credit due to GEORGE STEPHENSON for his labours in connection with the establishment of railways, it would be equally unfair to permit the names of those who assisted or preceded him in the useful work to be forgotten. The readers of the earlier numbers of the *Mining Journal*, when the railway system was being introduced, will be familiar with the name of WILLIAM HEDLEY, of Wylam, and although he has now passed away, so that no honour conferred upon him any pleasure, his three sons—Messrs. OSWALD, WILLIAM, and GEORGE HEDLEY—naturally desire to perpetuate their father's memory as the constructor of the very first successful locomotive engine, and, as the discoverer of the important fact—which alone rendered the success of the railway system possible—that, when at work, the adhesion of smooth wheels upon the rails was sufficient to produce progressive motion. In claims of this kind, there is not unfrequently a disposition on the part of the general public to assume that the claimant, and those immediately connected with him, are partial, and, therefore, not altogether reliable authorities; and it must be acknowledged that confirmatory evidence from a presumably adverse source is in every respect preferable. In the case of WILLIAM HEDLEY, there is not only the evidence afforded by the publications of the day, but, also, that which has fortunately been incidentally furnished by the biographers of GEORGE STEPHENSON and other engineers of the beginning of the century; and the only conclusion that can be drawn is that, had WILLIAM HEDLEY'S engineering skill and carefully made experiments not been available at Wylam, GEORGE STEPHENSON would have remained an ordinary engine-tenter, and the introduction of railways would have been long delayed."

From the Durham Chronicle, June 17th, 1881.

"It is admitted on all hands—and even the biographers of STEPHENSON do not deny—that HEDLEY was the first to start a

locomotive on plain rails; the failure of previous inventors lay in the groundless supposition that a locomotive on smooth wheels would not have had sufficient 'grip' upon the rails to drag a load after it. Hence they resorted to curious—and, if regarded in the light of present experience absurd—contrivances to enable their machinery to travel. TREVITHICK built his locomotives on the system of the stationery engines, and provided them with fanners to produce a blast, and spur-wheels to travel with. BLENKINSOP adopted a toothed-wheel to work into a rack-rail. BRUNTON gave his mechanical traveller a pair of legs to act as propellers behind. CHAPMAN used an endless chain working on a drum. All these expedients were at once cumbrous and unnecessary, and when HEDLEY, discarding them, set his engine upon plain rails and let it 'bite' by its own weight, he made a great stride towards giving his locomotive the proper conditions for work."

From The Life of George Stephenson. By SAMUEL SMILES, LL.D. *Centenary Edition, 1881.*

PAGE 34.

"The idea occurred to Mr. HEDLEY that it might be possible to secure sufficient adhesion between the wheel and the rail by the mere weight of the engine, and he proceeded to make a series of experiments for the purpose of determining this problem. He had a frame placed on four wheels, and fitted up with windlasses attached by gearing to the several wheels. The frame having been properly weighted, six men were set to work the windlasses; when it was found that the adhesion of the smooth wheels on the smooth rails was quite sufficient to enable them to propel the machine without slipping. Having then found the proportion which the power bore to the weight, he demonstrated by successive experiments that the weight of the engine would, of itself, produce sufficent adhesion to enable it to draw upon a smooth railroad the requisite number of waggons in all kinds of weather. And thus was the fallacy,

which had, heretofore, prevailed on this subject, completely exploded; and it was satisfactorily proved that rack-rails, toothed-wheels, endless chains, and legs, were alike unnecessary for the efficient traction of loaded waggons upon a moderately level road.

"From this time forward, considerably less difficulty was experienced in working the coal trains upon the Wylam tram-road. At length the rack-rail* was dispensed with. The road was laid with heavier rails†; the working of the old engine was improved; and a new engine was shortly after built and placed upon the road‡, still on eight wheels, driven by seven rack-wheels, spur-gear working inside them—with a wrought-iron boiler through which the flue was returned so as largely to increase the heating surface, and thus give increased power to the engine.

"As may readily be imagined, the jets of steam from the piston, blowing off into the air at *high pressure*§ while the engine was in motion, caused considerable annoyance to horses passing along the Wylam road, at that time a public highway. The nuisance was felt to be almost intolerable, and a neighbouring gentleman threatened to have it put down. To diminish the noise as much as possible, Mr. BLACKETT gave orders that so soon as any horse or vehicle drawn by horses, came in sight, the locomotive was to be stopped, and the frightful blast of the engine thus suspended until the passing animals had got out of sight.

"Much interruption was thus caused to the working of the railway, and it excited considerable dissatisfaction amongst the workmen. The following plan was adopted to abate the nuisance: a reservoir was provided immediately behind the chimney, into which the waste steam was thrown after it had performed its office in the cylinder; and from this reservoir

* There never was a rack-rail at Wylam. † No, not until 1830. ‡ May, 1813.
§ We have placed these two words in Italics.

the steam gradually escaped into the atmosphere* without noise. This arrangement was devised with the express object of preventing a blast in the chimney, the value of which, as we shall subsequently find, was not detected until GEORGE STEPHENSON, &c., &c."

PAGE 35.

"In the first place, STEPHENSON resolved to make himself thoroughly acquainted with what had already been done. Mr. BLACKETT's engines were working daily at Wylam, past the cottage in which he was born ; and thither he frequently went to inspect the improvements made by Mr. BLACKETT† from time to time, both in the locomotive and in the plate-way along which it worked. JONATHAN FOSTER informed us that, after one of these visits, STEPHENSON declared to him his conviction that a much more effective engine might be made, that should work more steadily and draw the load more effectively.‡"

From the Northern Daily Express, June 9, 1881.

"WILLIAM HEDLEY, who was born at Newburn, close to Wylam, in 1779, made his smooth-wheeled engines to run on smooth rails ; and demonstrated to the world, and proved to a demonstration, as a local engineer of to-day, Mr. R. L. GALLOWAY says—'The absence of the necessity for any further

* Dr. SMILES quite omits to say that the steam passed through a pipe into the chimney, and he makes no attempt to explain why, if Mr. HEDLEY never discovered the action of the blast pipe, he should have taken the trouble to contract the orifice of the pipe end in the chimney. We refer to pages 22 and 23 on this subject.

† HEDLEY.

‡ Subsequently, on seeing BLENKINSOP'S engine, STEPHENSON is reported to have said he could make a better one, to go upon legs. Evidently his ideas were of a very hazy kind, and these expressions of his read somewhat ridiculous. How was it he did not make a satisfactory locomotive until after HACKWORTH constructed the "Royal George"? The reason is well known—because he neglected two important features in HEDLEY'S locomotive, namely, the return-flue boiler, and the narrow chimney, without which, the blast, which he *did* adopt, could be of little use.

There are several inaccuracies in Dr. SMILES'S account of the first Wylam locomotives, which we have not touched upon, but we may say that the one constructed by WATERS, on HEDLEY'S design, and under his superintendence, was made at Wylam, and was immediately followed by HEDLEY'S second, and successful engine, shown on Plate 1.

aid than that supplied by the adhesion of the wheels to the rails.' * * * * * * *

"Merit and genius are not always rewarded, and the workers of to-day will not be encouraged by the systematic neglect of one, and the undue glorification of another."

From the York Herald, June 10, 1881.

"Having acquainted himself with the experiments of Mr. BLACKETT, of Wylam, and WILLIAM HEDLEY, his viewer, STEPHENSON began to make an engine, but while he adopted the plain wheels of HEDLEY and gave up the rack-rail of BLENKINSOP, he did not adopt the double tube which HEDLEY had found necessary, and his engine, which was tried on the Killingworth Railway on the 25th of July, 1814, while so far successful, did not answer altogether his expectations or realise his assertion about making a better engine than Mr. HEDLEY.

* * * * * * * *

"Mr. PEASE'S introduction to STEPHENSON, led to the establishment of the engine works at Newcastle, that have been so well known under STEPHENSON'S name. The engine-building was not at first successful, because the engines were not being brought into use, horses still maintaining their hold, and the controversy went on as to whether horse-power or steam, in the shape of standing engines or locomotives, were more advantageous or cheaper."

From the Newcastle Weekly Chronicle, June 11, 1881.

"According to the most trustworthy authorities, the man to whose genius it was reserved to contrive an arrangement which would dispense, once and for all, with rack-gearing, chain-barrels, and automatic legs, was Mr. WILLIAM HEDLEY, the enterprising viewer at Wylam Colliery. As unquestionably proved by public experiment at Wylam, in October 1812, to him is due the demonstration of the fact 'that the friction of the wheels of an engine-carriage upon the rails was sufficient

to enable it to draw a train of loaded waggons.' The 'Puffing Billy' now preserved in the Kensington Museum as a monument to HEDLEY's genius, and which did service on the Wylam Railway in 1813, was the first really successful enterprise of the kind. * * * * * * *

"Ignorance, jealousy, and prejudice, combined to make CUGNOT a beggar, to render TREVITHICK a poverty-stricken wanderer, and to cover HEDLEY with much unjust obscurity."

From Mr. ISAAC LOWTHIAN BELL'S *Paper on The Tyne as connected with the History of Engineering, read before the Members of the Institution of Mechanical Engineers, at their Annual Meeting, held at Newcastle-upon-Tyne, August 2nd,* 1881.

"For forty or fifty years the horse on the level, and the steam-engine, by means of ropes, on uneven ground, continued to labour on our iron roads in the conveyance of coal to its point of destination; when a crude idea of TREVITHICK's was taken hold of by Mr. BLACKETT, of Wylam, near this town, who, with the aid of his engineer, WILLIAM HEDLEY, constructed the first locomotive which ever did any work worthy of the name."

From the Colliery Guardian, July 29, 1881.

"The perusal of these quotations* can only produce one result, namely, to convince the reader that HEDLEY's work was the foundation on which STEPHENSON built; that but for WILLIAM HEDLEY, and his locomotive at Wylam, we should possibly never have heard of GEORGE STEPHENSON as a railway hero; and, it is repugnant to that sense of fairplay, which is inherent in the English breast, that the laurels of engineering skill and patience should be all placed on the head of one man, to the injury of the fame of another who has a just right to share them."

* From REYNOLDS' "Model Locomotive Engineer."

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